were weaned, four survived (30 days follow-up). **Conclusions** Left ventricular unloading with the Impella® pump increases blood pressure and cardiac output in patients with severe cardiogenic shock, resulting in a decrease in blood lactate levels.

POSTER SESSION

## 1209 Exercise Testing in Heart Failure Patients

Tuesday, April 01, 2003, 3:00 p.m.-5:00 p.m.
McCormick Place, Hall A
Presentation Hour: 4:00 p.m.-5:00 p.m.



### 1209-59 Peak VO2 and VE/VCO2 Slope in Patients With Heart Failure: A Prognostic Comparison

Syed S. Aslam, Ross Arena, Jonathan Myers, Elsa Varughese, Mary Ann Peberdy, Virginia Commonwealth University, Medical School of Virginia, Richmond, VA, Stanford University, Palo Alto, CA

**Background:** Exercise testing with ventilatory expired gas analysis has consistently proven to be a valuable tool for risk stratifying patients with chronic heart failure (CHF). Peak oxygen consumption ($VO_2$) continues to be the standard for assessing prognosis in this population. However, it has recently been suggested that the minute ventilation - carbon dioxide production relationship (VE/VCO2 slope) may be an even more powerful predictor of events than peak $VO_2$ in CHF.
**Methods:** Two hundred and thirty five subjects with CHF underwent exercise testing between 3/18/93 to 10/19/01. The ability of peak $VO_2$ and the $VE/VCO_2$ slope to predict cardiac-related mortality and hospitalization were examined.
**Results:** Mean follow-up time was 33±27 months, and the annual mortality rate was 5.0%. Univariate Cox regression analysis found peak $VO_2$ and $VE/VCO_2$ slope to both be significant predictors of cardiac-related mortality and hospitalization ($p<0.001$). Multivariate analysis revealed peak $VO_2$ added additional value to the $VE/VCO_2$ slope in predicting cardiac-related hospitalization, but not mortality. Receiver operating characteristic (ROC) curve analysis demonstrated the $VE/VCO_2$ slope to be a significantly better predictor of cardiac-related mortality than peak $VO_2$ ($p<0.05$). Although area under the ROC curve for the $VE/VCO_2$ slope was greater than peak $VO_2$ in predicting cardiac-related hospitalization (0.78 vs. 0.73), the difference was not statistically significant ($p=0.08$).
**Conclusion:** The $VE/VCO_2$ slope is an important predictor of outcomes in CHF. Risk stratification is optimized by combining peak $VO_2$ with the VE/VCO2 slope.

### 1209-60 Correlation of Brain Natriuretic Peptide Release, Cardiopulmonary Exercise Testing, and Six-Minute Walking Test in Patients With Heart Failure and Cardiac Resynchronization Therapy

Anil M. Sinha, Karsten Filzmaier, Dagmar Kunz, Kai U. Markus, Juergen Graf, Ole A. Breithardt, Peter Hanrath, Christoph Stellbrink, University Hospital Aachen, Aachen, Germany

Background: Brain natriuretic peptide (BNP) levels are elevated in reduced left ventricular function. Cardiac resynchronization therapy (CRT) improves cardiac hemodynamics and functional status in heart failure patients (pts). We investigated the effects of CRT on BNP levels, cardiopulmonary exercise testing (CPX) and 6 min walking test (WT) in these pts.
Methods: 20 pts (16m, 65±10y) with a mean EF 24±5%, LBBB (QRS 167±25 ms) and CRT were investigated. CPX was performed on a bicycle with incremental work load. Maximum (VO2max) and oxygen consumption at the anaerobic threshold (VO2-AT) were measured. WT was performed on 45 m long plain floor. BNP levels were determined with the Triage BNP test (Biosite Diagnostics, USA). Data were collected before pacemaker implantation (baseline) and after 15±8 weeks of CRT (VDD mode). As BNP levels are influenced by renal function, serum creatinine and blood urea nitrogen (BUN) levels were measured simultaneously. Results: The effects of CRT on BNP levels, CPX, WT and renal function are shown in the table. Correlation coefficient r was calculated as change of values vs BNP levels during CRT (#$p<0.05$).
Conclusion: Chronic CRT leads to a significant decrease in BNP release and improvement of exercise capacity. As there is an inverse correlation between change in BNP levels and CPX parameters, decreasing BNP levels seem to be an indicator for improved functional status and therapeutic efficacy of CRT in patients with advanced heart failure and LBBB.

Effects of CRT (mean±SD; *$p<0.05$ vs baseline; #$p<0.05$)

| | BNP (pg/ml) | VO2-AT (ml/min/kg) | VO2max (ml/min/kg) | 6 WT (m) | Creatinine (mg/dl) | BUN (mg/dl) |
|---|---|---|---|---|---|---|
| Baseline | 525+/-313 (132-1250) | 10.6+/-2.3 | 12.9+/-3.2 | 355+/-106 | 1.5+/-0.5 | 56+/-28 |
| CRT | 268+/-228* (63-956) | 12.5+/-2.1* | 16.0+/-3.8* | 413+/-108* | 1.6+/-0.7 | 63+/-29 |
| Correlation r vs BNP | | -0.58# | -0.56# | -0.16 | | |

### 1209-61 Physical Training-Induced Reduction of Peripheral Monocyte-Related Inflammatory Markers Is Associated With Improvement in Endothelial Function of Chronic Heart Failure Patients

Stamatis Adamopoulos, John T. Parissis, Dimitrios Karatzas, Christos Kroupis, George Karavolias, Katerina Koniavitou, Spilios Karas, Dimitrios Kremastinos, Onassis Cardiac Surgery Center, Athens, Greece, Amalia Fleming Hospital, Athens, Greece

Aim: To investigate whether the effects of physical training (PT) on serum monocyte-related inflammatory markers such as tumor necrosis factor-a (TNF-a), granulocyte-macrophage colony-stimulating factor (GM-CSF), macrophage chemoattractant protein-1 (MCP-1), soluble intercellular adhesion molecule-1 (sICAM-1) and soluble vascular cell adhesion molecule-1 (sVCAM-1), are associated with changes in peripheral blood flow and endothelial function of patients with chronic heart failure (CHF).
**Methods:** Serum levels of these markers were assessed by ELISA in 15 CHF patients (ischemic:7, dilated:8, NYHA:II-III, EF:23±3%) before and after a 12-week program of PT in a randomised crossover design. Peak oxygen uptake (VO2max) was used to estimate functional status of CHF patients and venous occlusion plethysmography to assess endothelial function through reactive hyperemia-induced vasodilatation.
**Results:** PT produced a significant reduction in TNF-a (7.2±1.1 vs 4.9±0.9 pg/ml, $p<0.01$), GM-CSF (26.5±1.9 vs 20.6±1.5 pg/ml, $p<0.02$), MCP-1 (191±5 vs 175±5 pg/ml, $p<0.001$), sICAM-1 (385±29 vs 322±26 ng/ml, $p<0.005$) and sVCAM-1 (1309±98 vs 1121±89 ng/ml, $p<0.005$), as well as an increase in VO2max (14.8± 1 vs 16.7±1 ml/kg/min, $p<0.01$). A significantly higher (54%, $p<0.05$) increase in forearm blood flow in response to reactive hyperemia was observed after PT (from 2.7±0.3 to 4.3±0.6 ml/100 ml tissue/min) compared with 16.7% after detraining (from 2.2±0.5 to 2.5±0.4 ml/100 ml tissue/min).Significant correlations were found between PT-induced changes in VO2max and molecules sICAM-1 ($r=-0.65$, $p<0.02$) and sVCAM-1 ($r=-0.60$, $p<0.05$), as well as PT-induced changes in peripheral blood flow and molecules TNF-a ($r=-0.56$, $p<0.05$), sICAM-1 ($r=-0.54$, $p<0.05$) and sVCAM-1 ($r=-0.68$, $p<0.05$). A good correlation was also found between PT-induced increase in peripheral blood flow and VO2max ($r=0.70$, $p<0.05$).
**Conclusions:** PT reduces peripheral monocyte-related inflammatory markers in CHF. These immunomodulatory effects of PT may be related with the improvement in exercise capacity of CHF patients, possibly by increasing peripheral blood flow and improving endothelial function.

### 1209-62 Effects of Cardiac Resynchronization With Biventricular Pacing on the Symptoms, Left Ventricular Function, and Hemodynamic Data of the Patients With Heart Failure and Increased QRS Duration

Marco Metra, Antonio Curnis, Giosué Mascioli, Luca Bontempi, Roberto Procopio, Lidia Culot, Savina Nodari, Livio Dei Cas, University of Brescia, Brescia, Italy

**Background:** Controlled clinical trials have shown the beneficial effects of biventricular pacing (BVP) in patients with heart failure (HF) and left bundle branch block. The effect of CRT on the hemodynamic response to exercise (ex) have not been studied, yet.
**Methods:** Eighteen consecutive patients with chronic HF, QRS duration >150 msec and left ventricular ejection fraction (LVEF) < 35% were studied by MUGA and cardiopulmonary ex test with simultaneous Swan-Ganz cath, before and after 6 months of CRT with BVP.
**Results:** After 6 months of BVP LVEF increased from 20±8% to 25±12% ($p=0.03$), peak $VO_2$ from 13.6±3.3 to 14.9±3.1 ml/kg/min ($p=0.017$) and from 50±16 to 58±11% of maximal predicted values ($p=0.018$); $VO_2$ at the anaerobic threshold from 9.8±3.3 to 11.5±2.7 ml/kg/min ($p=0.019$) and the half-time of post-ex $VO_2$ recovery shortened from 150±78 to 119±42 secs ($p=0.032$). The $VE/VCO_2$ slope declined from 44±13 to 39±13 ($p=0.05$). Hemo data in table (* $p<0.05$; † $p<0.01$)

| | Rest | | Peak exercise | |
|---|---|---|---|---|
| | Baseline | BV Pacing | Baseline | BV pacing |
| Heart rate, bpm | 77±14 | 71±10 | 117±21 | 107±17 |
| Cardiac index, L/min/m$^2$ | 2.26±0.57 | 2.39±0.55* | 3.69±1.22 | 4.24±1.44† |
| Stroke volume index, ml/b/ m$^2$ | 31±11 | 35±12* | 32±11 | 40±14† |
| Pulmonary wedge pressure, mm Hg | 22±9 | 17±9 | 35±10 | 30±8 |
| Right atrial pressure, mm Hg | 14±7 | 12±5 | 11±6 | 11±5 |

The change in the peak ex cardiac index (CI) correlated with that in peak $VO_2$ ($r = 0.49$; $p = 0.04$) and was the only variable predictive of its increase at multiple regression analysis.
**Conclusions:** BVP is associated with an improvement in resting LVEF, resting and peak ex stroke volume index and CI and of maximal ex capacity. The improvement in the LV systolic function, with an heightened peak ex CI, contributes to the increase of the ex capacity.